Another New, Nearly Extinct Species of *Hibiscadelphus* (Malvaceae) from the Hawaiian Islands

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ABSTRACT. Four individuals of a new species of *Hibiscadelphus* (Malvaceae: Hibisceae) have been discovered on Kaua'i, the oldest of the major Hawaiian Islands. *Hibiscadelphus woodii* is described and illustrated, and its status and basal relationship within the genus are discussed. The imperiled status of the other six species is reviewed, and a key to the genus is given.

Hibiscadelphus Rock consists of seven species endemic to the Hawaiian Islands (Bates, 1990), including the one described herein. The genus was originally established by Joseph F. Rock (Radlkoffer & Rock, 1911) to accommodate three species of shrubs or small trees that he had collected from dryland forests: two species on the island of Hawai'i, *H. giffardianus* Rock (Mauna Loa) and *H. hualalaiensis* Rock (Hualalai), and *H. wilderianus* Rock from Auwahi on East Maui. Four additional species were subsequently described: *H. bombycinus* C. Forbes from the Kohala Mountains on the island of Hawai'i (Forbes, 1920), *H. distans* L. Bishop & Herbst from the Koai'e Canyon of Kaua'i (Bishop & Herbst, 1973), *H. crucibracteatus* Hobdy from Puhielelu Ridge on Lana'i (Hobdy, 1984), and the new species, *H. woodii*, described herein from Kalalau Valley, Kaua'i.

Hibiscadelphus is a member of the tribe Hibisceae, represented in the Hawaiian Islands by the indigenous genus *Hibiscus* L., following Fryxell's (1968) classification. Although closely related to *Hibiscus* (the generic name means "brother of *Hibiscus*"), *Hibiscadelphus* is clearly a distinct monophyletic group based on its curved and narrowly convolute zygomorphic corollas with the lower two lobes shorter than the other three, calyces that are circumscissily deciduous in fruit, and relatively thick, woody capsules (Hobdy, 1984; Bates, 1990). The green, yellow, or magenta flowers with tubular, curved corollas are presumably adapted to pollination by native Meliphagid and Drepanidine birds, known as the honeyeaters and honeycreepers (Hobdy, 1984). The Hawaiian name for members of the genus is *hau kuahiwi*, meaning upland or mountain hau, because of their resemblance to the common lowland hau, *Hibiscus tiliaceus* L. (Rock, 1913; Bates, 1990).

Due to the destruction and severe alteration of the diverse dry and mesic forest habitats and loss of all of the Meliphagid birds in the Hawaiian Islands (Hobdy, 1984), five of the seven *Hibiscadelphus* species have become extinct in the wild, although at least two of these are maintained through cultivated plants: *H. giffardianus* and *H. hualalaiensis*. Only *H. distans*, a U.S. federally listed endangered species, and the new species described in this paper have naturally occurring wild populations (Table 1; Bates, 1990). The status of the genus is extremely precarious at present.

In March 1991 an unusual species of *Hibiscadelphus* not corresponding with any of the described taxa was discovered on Kaua'i by Kenneth R. Wood, staff member of the National Tropical Botanical Garden, along with M. Query and S. Montgomery. Four plants were found growing on a steep slope below the rim of Kalalau Valley in northwestern Kaua'i (K. R. Wood, 1992, unpublished). Study of flowering specimens has revealed that they represent a new species.

Hibiscadelphus woodii Lorence & W. L. Wagner, sp. nov. TYPE: Hawaiian Islands. Kaua'i: Hanalei District, Kalalau Rim, N of Kahuama'a Flat, steep diverse lowland mesic forest, 990–1020 m, 3 Mar. 1991, *K. R. Wood, M. Query & S. Montgomery 629* (holotype, PTBG, a flower also in spirit collection; isotypes, BISH, K, MO, NY, US). Figure 1.

Species foliis glabratis vel venis sparsim stellato-puberulis, pagina abaxiali laminae axillis venarum trichomatibus stellatis instructis, calyce trichomatibus stellatis cum radiis 5–8 ornatis, corolla cerina cupreo-suffusa atropurpurescentia distinguibilis.

Table 1. Status of species of *Hibiscadelphus* (D. Ragone, unpublished observations, 1993). DOFAW = Division of Forestry and Wildlife, Department of Land and Natural Resources, State of Hawaii (plantings at Pu'uwa'awa'a, Kona, Hawai'i Island); HVNP = Hawaii Volcanoes National Park (planting at Kipuka Puaulu, Hawai'i Island); NTBG = National Tropical Botanical Garden (plantings at Lawai and Limahuli Gardens, Kaua'i); WA = Waimea Arboretum (plantings at Haleiwa, O'ahu).

Species	Distribution	Wild populations	Known individuals	
			Wild	Cultivated
H. bombycinus	Hawai'i (Kohala Mts.)	Extinct	—	—
H. crucibracteatus	Lana'i (Puhielelu Ridge)	Extinct	—	—
H. distans	Kaua'i (Koai'e Canyon)	2	137	39 NTBG 14 WA
H. giffardianus	Hawai'i (Mauna Loa)	Extinct	—	7 HVNP 1 NTBG 8WA
H. hualalaiensis	Hawai'i (Hualalai)	Extinct	—	3 NTBG 20–30 DOFAW
H. wilderianus	East Maui (Auwahi)	Extinct	—	—
H. woodii	Kaua'i (Kalalau Valley)	1	4	—

Small branched trees 2.5–5 m tall with dense rounded crown, trunk with DBH 10–20 cm, the twigs glabrate. Leaves with petioles 2.8–5.8 cm long bearing scattered stellate trichomes when young, glabrate; stipules subulate, 3–5 mm long, sparsely stellate-pubescent; blade broadly ovate to very broadly ovate, 7–9 cm long, 6.5–8.4 cm wide, thin-coriaceous, drying chartaceous; adaxially glabrate or with scattered small, translucent stellate trichomes on principal veins, abaxially with few scattered stellate trichomes on principal veins or glabrate, with sparse tufts of stellate trichomes in major vein axils, when young with scattered stellate trichomes along margins and at junction with petiole, the base deeply cordate, occasionally shallowly so, the apex acute to weakly acuminate or broadly obtuse, the principal veins 5 (7), the margins irregularly and coarsely crenate-dentate. Flowers solitary, the peduncles 1.4–2.1 cm long, sparsely stellate pubescent; involucral bracts 4–6, free essentially to their base, 11–15 mm long, 1.8–4 mm wide, linear-oblong; calyx tubular, 1.3–1.5 cm long (up to 1.7 cm when fresh), green, shallowly 5-lobed, the lobes 2–3 mm long, sometimes in age splitting further, moderately densely pubescent with stellate trichomes composed of 5–9 horizontal radiating arms free to their base; corolla 45–47 mm long, stellate pubescent, yellow with coppery tinge when fresh, rapidly becoming purplish maroon, the lobes 35–40 mm long, 10–12 mm wide, with conspicuous veins, moderately stellate pubescent with trichomes becoming restricted to veins in inner ⅓ of lobes abaxially; staminal column exserted ca. 7 mm beyond corolla lobes, stigmas ca. 1 mm long, subglobose, reddish brown, villosulous, exserted 14 mm beyond corolla lobes; style villous; ovary 7 mm long, 4–5 mm wide, 5-angled, stellate pubescent, endocarp segments apparently 10 (in cross section). Fruit unknown.

Distribution and habitat. The new species is known only from a population of four trees at the type locality—accessible only with climbing ropes. It occurs on a steep slope of predominantly basalt talus with patches of brown soil and leaf litter in remnant diverse lowland mesic forest. Associated native taxa include *Melicope pallida* (Hillebrand) T. Hartley & B. Stone, *Nototrichium* sp. nov., *Hedyotis* sp. nov., *Chamaesyce* sp. nov., *Lysimachia glutinosa* Rock, *L. kalalauensis* Skottsberg, *Poa mannii* Munro ex Hillebrand, *Stenogyne campanulata* Weller & Sakai, and *Lobelia niihauensis* St. John. The alien daisy fleabane, *Erigeron karvinskianus* DC., is an extremely invasive perennial herb that threatens to overrun and smother the native cliff habitat in this region. Accessible areas above these cliffs have been severely degraded by feral goats and pigs. The *Hibiscadelphus woodii* plants are also susceptible to damage by falling rocks dislodged by these animals, which aggravate erosion.

Reproduction and conservation. Flowering material has been collected in March, April, and Sep-

Figure 1. *Hibiscadelphus woodii* Lorence & W. L. Wagner. Habit. Scale = 1 cm.

tember, but no fruit set has been observed in spite of efforts to manually outcross and bag the flowers. Introduced birds, i.e., the Japanese white eye (*Zosterops japonicus*), were seen piercing the corollas above the calyx, presumably robbing nectar (note on *Wood et al. 640*). A liquid-preserved flower of *Wood 726* contained three adult Nitidulidae beetles probably representing an endemic species (D. Jamieson, pers. comm.). The flower also contained two half-grown larvae of the endemic moth *Crocidosema marcidella* (Walsingham) (Lepidoptera: Tortricidae), which had completely eaten the style down to the ovary. Larvae of Hawaiian *Crocidosema* species are known to feed on indigenous Malvaceae fruits and foliage (Zimmerman, 1978), and damage by these larvae may be responsible for the observed

lack of fruit set in *H. woodii*. Attempts to propagate the new species by air layering, cuttings, grafts, and tissue culture thus far have failed.

We take pleasure in naming this new species for Kenneth R. Wood, in recognition of his continued efforts to understand and protect the rare and endangered plants of the Hawaiian Islands, especially those of Kalalau Valley.

Paratypes. HAWAIIAN ISLANDS. **Kaua'i:** Hanalei District, Kalalau Rim, N of Kahuama'a Flat, steep diverse lowland mesic forest, 990–1000 m, 6 Mar. 1991, *K. R. Wood et al. 640* (BH), 15 Apr. 1991, *K. R. Wood et al. 726* (PTBG), 23 Sep. 1991, *K. R. Wood & S. Perlman 1600* (PTBG).

Affinities. *Hibiscadelphus woodii* differs from its congeners in having leaves that are glabrate except for rare stellate trichomes adaxially and sparse stellate trichomes on the veins and in the principal vein axils abaxially, stellate trichomes on the calyx with rays free to the base, and yellow corollas with a coppery tinge, rapidly becoming purplish maroon with age. *Hibiscadelphus distans* differs in its involucral bracts connate for about one-third of their length, multi-rayed calyx trichomes of two sizes, a smaller yellowish green corolla rapidly becoming dull reddish, and densely stellate pubescence on the corolla with the trichomes becoming restricted to the veins on the inner one-third of the lobes abaxially. *Hibiscadelphus giffardianus* differs from *H. woodii* in having filiform involucral bracts up to 1.1 mm wide, whereas those of *H. hualalaiensis* are short, triangular teeth only 0.5–3 mm long. *Hibiscadelphus crucibracteatus* differs in having longer involucral bracts (20–30 mm), whereas *H. wilderianus* has a longer calyx (2.3–2.5 cm). *Hibiscadelphus bombycinus* differs from *H. woodii* in having leaves with the lamina densely pubescent beneath and a shorter corolla (3.3 cm). Fruiting material, unknown for *H. woodii*, is required to further assess its affinities. Examination of transverse hand-cut sections of a flowering ovary of *H. woodii* suggests the endocarp will separate into ten segments in fruit as in *H. bombycinus*, *H. crucibracteatus*, *H. giffardianus*, *H. hualalaiensis*, and *H. wilderianus*, rather than into five boat-shaped segments as in *H. distans*.

The phylogenetic relationships of this unique Hawaiian endemic genus were recently analyzed (Funk & Wagner, 1995). In the single cladogram resulting from their morphological study the position occupied by *Hibiscadelphus woodii* is basal. Because fruit characters are among the most important ones for determining the tree topology, the placement of *H. woodii* is in doubt. Their analysis estimated that the fruit character of *H. woodii* is plesiomorphic (i.e., chartaceous, not woody) as in *H. distans*. In order to investigate the stability of the basal position of *H. woodii* in the phylogeny they recoded the missing character as apomorphic. Even with this change, however, *H. woodii* remained in the basal position. Species of *Hibiscadelphus* may be separated by characters given in the following key (adapted from Bates, 1990).

KEY TO THE SPECIES OF *HIBISCADELPHUS*

1a. Involucral bracts connate ca. ⅓ of their length; mesocarp weakly developed and usually adnate to exocarp; endocarp segments 5, boatlike; Koai'e Canyon, Kaua'i ..... *H. distans*
1b. Involucral bracts free or connate slightly at base; reticulate mesocarp strongly developed; endocarp segments 10.
  2a. Involucral bracts filiform or obsolete, up to 1.1 mm wide.
    3a. Involucral bracts 0.5–2(–3) mm long; corolla yellowish green, fading to purplish within, 2–5(–5.5) cm long; Hualalai, Hawai'i ..... *H. hualalaiensis*
    3b. Involucral bracts 18–35 mm long (hybrids between *H. giffardianus* and other species tend to have bracts 5–15 mm long); corolla grayish green externally, dark magenta within, (5–)6–7 cm long; Mauna Loa, Hawai'i ..... *H. giffardianus*
  2b. Involucral bracts linear to spatulate, 1–7 mm wide.
    4a. Involucral bracts 20–30 mm long, 3–7 mm wide; calyx 4.2–4.9 cm long; corolla 5–6.5 cm long; Puhielelu Ridge, Lana'i ..... *H. crucibracteatus*
    4b. Involucral bracts 9–18 mm long, 1.5–4 mm wide; calyx 1.3–2.5 cm long; corolla 3.3–4.7 cm long.
      5a. Leaf lamina adaxially glabrate or with minute, scattered, stellate trichomes only on principal veins, abaxially glabrate or with scattered stellate trichomes only on principal veins, the trichomes sparsely tufted in principal vein axils; Kalalau Valley, Kaua'i ..... *H. woodii*
      5b. Leaf lamina adaxially sparsely stellate pubescent, abaxially sparsely to densely stellate pubescent, the trichomes densely tufted in principal vein axils; Mauai, Hawai'i.
        6a. Involucral bracts 9–10 mm long; calyx ca. 1.2 cm long; Kohala Mts., Hawai'i ..... *H. bombycinus*
        6b. Involucral bracts 11–18 mm long; calyx 2.3–2.5 cm long; Auwahi, East Maui ..... *H. wilderianus*

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